FINAL SUBMITTAL

ENERGY ENGINEERING ANALYSIS PROGRAM

ENERGY SAVINGS OPPORTUNITY SURVEY

FORT LEE

PETERSBURG, VIRGINIA

EXECUTIVE SUMMARY

CONTRACT NO. DACA65-91-C-0048

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS
NORFOLK, VIRGINIA

PREPARED BY:

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ENERGY AND ENVIRONMENTAL SERVICES DEPARTMENT
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PROJECT NO. 2900379004

APRIL 1993

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

1.1 Authorization

The Energy Engineering Analysis Program (EEAP), Energy Savings Opportunity Survey (ESOS), Fort Lee, Petersburg, Virginia was authorized by the Department of the Army, Norfolk District Corps of Engineers, under Contract Number DACA65-91-C-0048.

1.2 Objectives

The objectives of this contract, as explained in the Detailed Scope of Work (Appendix A in Volume II) of the contract are as follows:

A. Review for general information any energy studies which were performed at this installation.

B. Evaluate selected ECOs to determine their energy savings potential and economic feasibility.

C. Perform a comprehensive site survey, identify all ECOs, including low cost/no cost ECOs and perform evaluations of each.

D. Provide complete programming or implementation documentation for all recommended ECOs.

E. Determine the efficiency of small boilers (less than 3.5 MBtu/hr) by appropriate tests and determine if efficiency can be improved or fuel saved by the repair, addition or modification of equipment, control systems and maintenance practices and recommend improvements.

F. Prepare a comprehensive report to document the work performed, the results and the recommendations.

1.3 Report Organization

The report consists of five volumes. Volume I, the Narrative Report, contains the results of all of the site surveys, analysis and project development. The Detailed Scope of Work, Prenegotiation Minutes and all backup data and calculations are found in Volume II. The site survey notes are in Volume III and project documentation forms necessary for receiving funding are in Volume IV. An Executive Summary volume is also included.

2.0 INSTALLATION DESCRIPTION

2.1 Installation Description

Fort Lee, the headquarters of the U.S. Army's Logistics Center, is a Training and Doctrine Command (TRADOC) installation. The primary function of TRADOC installations is to train and educate troops. Fort Lee is very much like a college campus. It has classroom buildings, dormitories (barracks), office buildings, gymnasiums and many other building types found on any college campus. The installation site plan is shown in Figure 2-1.

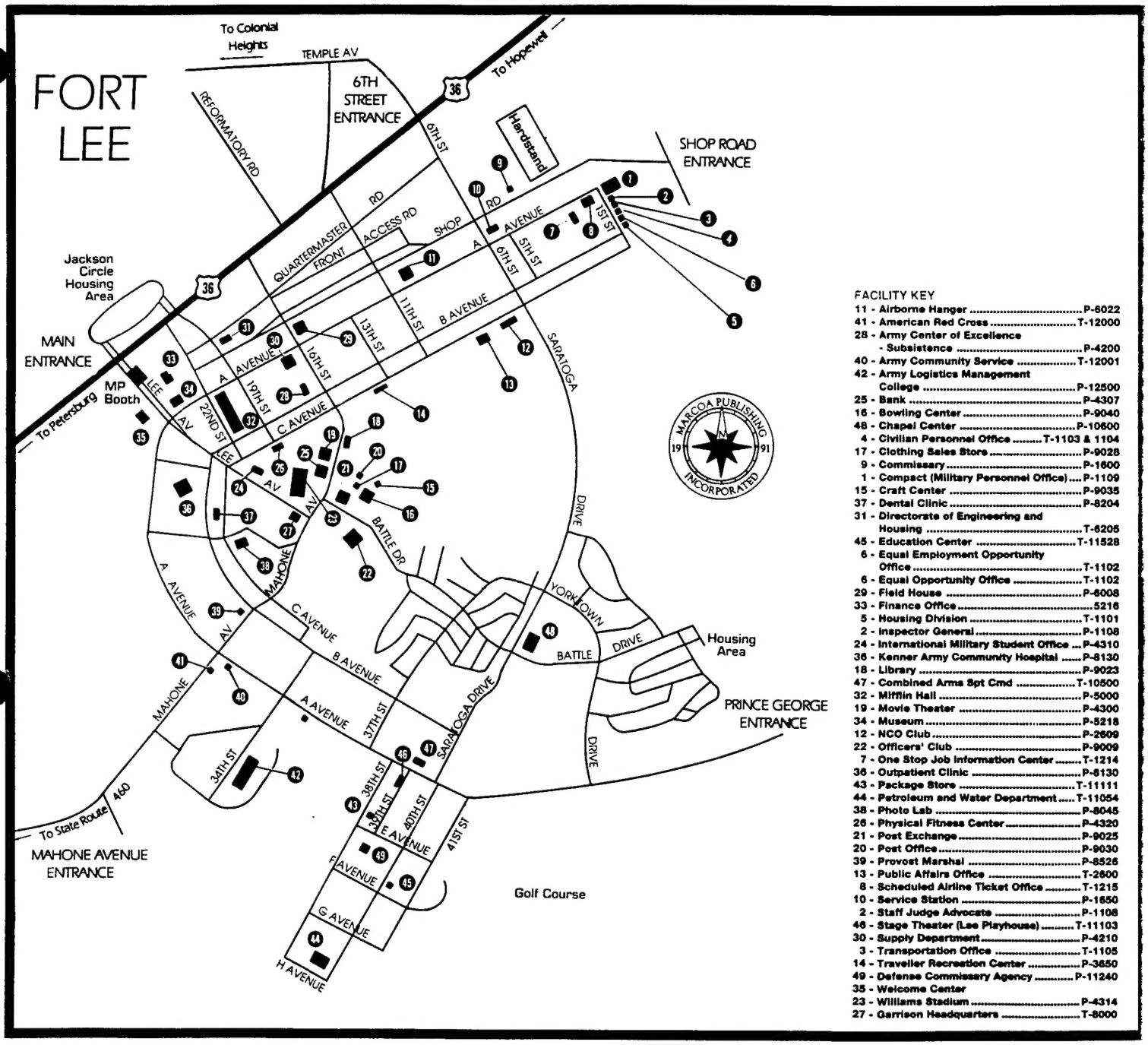
2.2 Facilities Description

Fort Lee has close to 7.5 million square feet of floor space in over 600 buildings and 1,459 family housing units. Table 2-1 below is an approximation of the breakdown of floor space by building type. Family and other military housing represent about one-half of the total floor space and administration types (schools and offices), twenty-five percent.

Table 2-1. Fort Lee Building Inventory Statistics

Building Type	Gross Area (sf)	Number Buildings	Average Area (sf)
School	919,360	64	14,365
Maintenance	167,494	24	6,979
Storage (heated)	555,067	211	2,631
Office	1,000,997	126	7,944
Military Housing	1,642,168	97	16,930
Community Fac.	504,112	54	9,335
Commissary/Clubs	143,583	3	47,861
Utilities	14,497	10	1,450
Hospital	137,200	1	137,200
Clinics	31,411	6	5,235
Others	118,708	28	4,240
Totals	5,234,597	624	8,389
Family Housing	2,100,000	1,459 [1]	1,439
Grand Total	7,334,597		

[1]Units



FACILITY KEY

11 - Airborne Hanger	P-6022
41 - American Red Cross	T-12000
28 - Army Center of Excellence - Subsistence	P-4200
40 - Army Community Service	T-12001
42 - Army Logistics Management College	P-12500
25 - Bank	P-4307
16 - Bowling Center	P-9040
48 - Chapel Center	P-10600
4 - Civilian Personnel Office	T-1103 & 1104
17 - Clothing Sales Store	P-9028
9 - Commissary	P-1600
1 - Compact (Military Personnel Office)	P-1109
15 - Craft Center	P-9035
37 - Dental Clinic	P-8204
31 - Directorate of Engineering and Housing	T-6205
45 - Education Center	T-11528
6 - Equal Employment Opportunity Office	T-1102
6 - Equal Opportunity Office	T-1102
29 - Field House	P-6008
33 - Finance Office	5216
5 - Housing Division	T-1101
2 - Inspector General	P-1108
24 - International Military Student Office	P-4310
36 - Kenner Army Community Hospital	P-8130
18 - Library	P-9023
47 - Combined Arms Spt Cmd	T-10500
32 - Mifflin Hall	P-5000
19 - Movie Theater	P-4300
34 - Museum	P-5218
12 - NCO Club	P-2609
22 - Officers' Club	P-9009
7 - One Stop Job Information Center	T-1214
36 - Outpatient Clinic	P-8130
43 - Package Store	T-11111
44 - Petroleum and Water Department	T-11054
38 - Photo Lab	P-8045
26 - Physical Fitness Center	P-4320
21 - Post Exchange	P-9025
20 - Post Office	P-9030
39 - Provost Marshal	P-8526
13 - Public Affairs Office	T-2600
8 - Scheduled Airline Ticket Office	T-1215
10 - Service Station	P-1650
2 - Staff Judge Advocate	P-1108
46 - Stage Theater (Lee Playhouse)	T-11103
30 - Supply Department	P-4210
3 - Transportation Office	T-1105
14 - Traveller Recreation Center	P-3650
49 - Defense Commissary Agency	P-11240
35 - Welcome Center	
23 - Williams Stadium	P-4314
27 - Garrison Headquarters	T-8000

Figure 2-1
Fort Lee Site Map

Source: Reynolds, Smith and Hills, Inc., 1992

3.0 ENERGY CONSUMPTION AND COSTS

All historical energy use and cost data were gathered from the U.S. Army Data DEIS (Defense Energy Information System) system, or ADDS. FY 91 detailed data were received from Fort Lee Engineering and varies slightly from the ADDS data.

3.1 Energy Use. Total facility and production energy consumption at Fort Lee decreased by approximately 11 percent from FY 85 through FY 91 (Figure 3-1). The cause for the decrease was due to decrease in the use of natural gas and fuel oil which decreased 17 percent and 52 percent, respectively. Electricity consumption increased 22 percent over the same time period.

Monthly consumption of heating fuels and electricity for FY 88 - FY 91 is shown in Figure 3-2. The strong dependence of heating fuels on weather is readily apparent, although some thermal energy is required during the summer months for uses other than space heating (domestic hot water, humidity control and electricity generation). Electricity use is fairly constant throughout the year, with peaks occurring in the summer months due to air conditioning.

Percentages of fuel use for FY 91 are shown in Figure 3-3. The heating fuels accounted for approximately 57 percent of energy use in that year and electricity the remainder.

3.2 Costs. Total annual energy costs at Fort Lee, $5,200,000 in FY 91, have decreased 17 percent over the FY 85 values (Figure 3-4). The changes in costs reflect changes in unit pricing over the same time period (Figure 3-5). Current energy prices are shown in the table below. These prices are based on averages for FY 91 except for electricity. Electricity prices are based on the rate schedule information supplied by the local utility, Virginia Power.

Fort Lee
Historical Energy Use

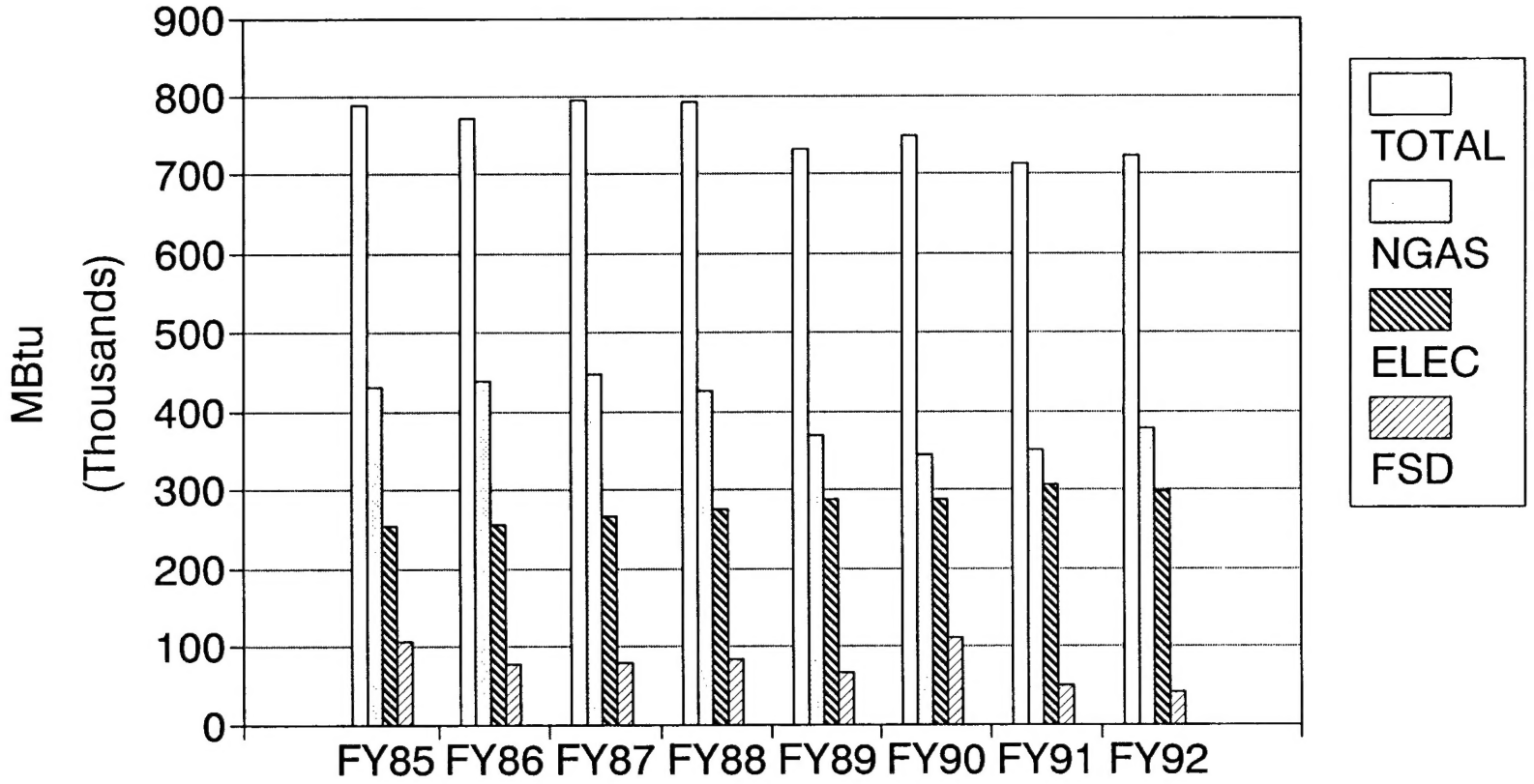


Figure 3-1

Source: ADDS

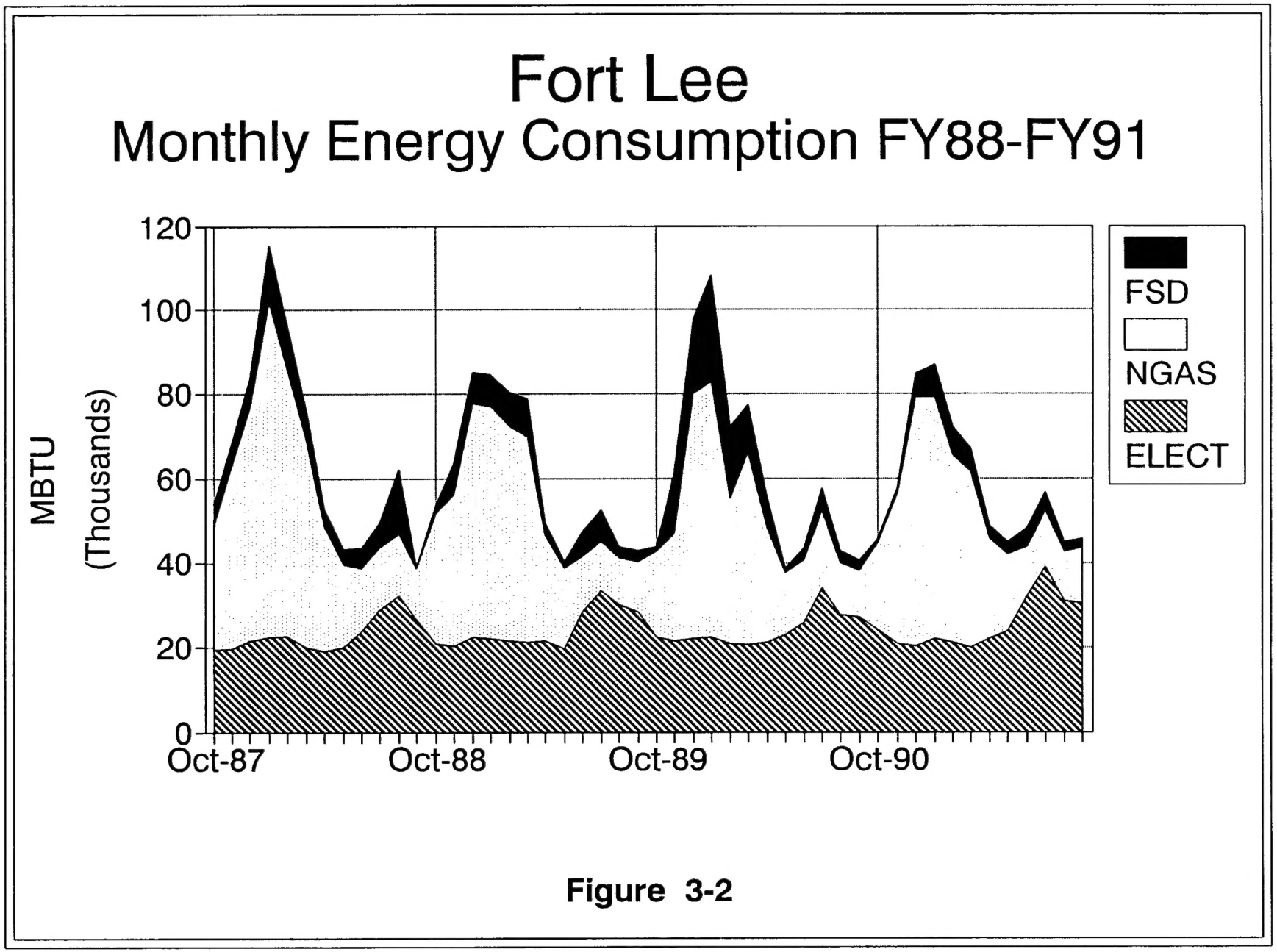
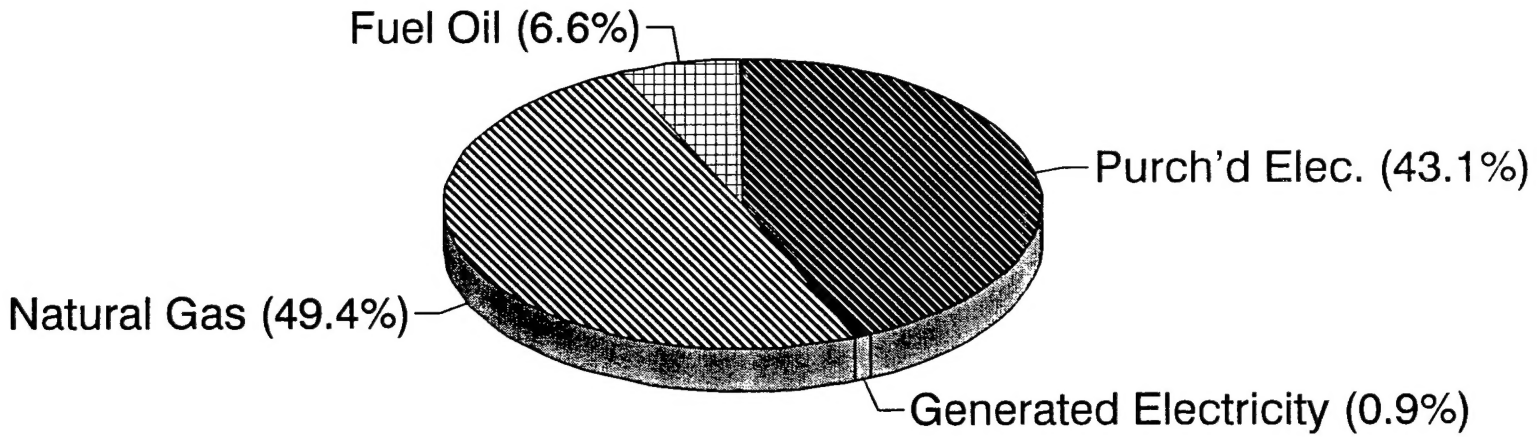

Fort Lee
Monthly Energy Consumption FY88-FY91
MBTU
(Thousands)
120
100
80
60
40
20
0
Oct-87
Oct-88
Oct-89
Oct-90
FSD
NGAS
ELECT

Figure 3-2

FORT LEE

FY91 Facility Energy Use



Total Use = 712,600 MBtu

Figure 3-3

Fort Lee
Historical Energy Cost

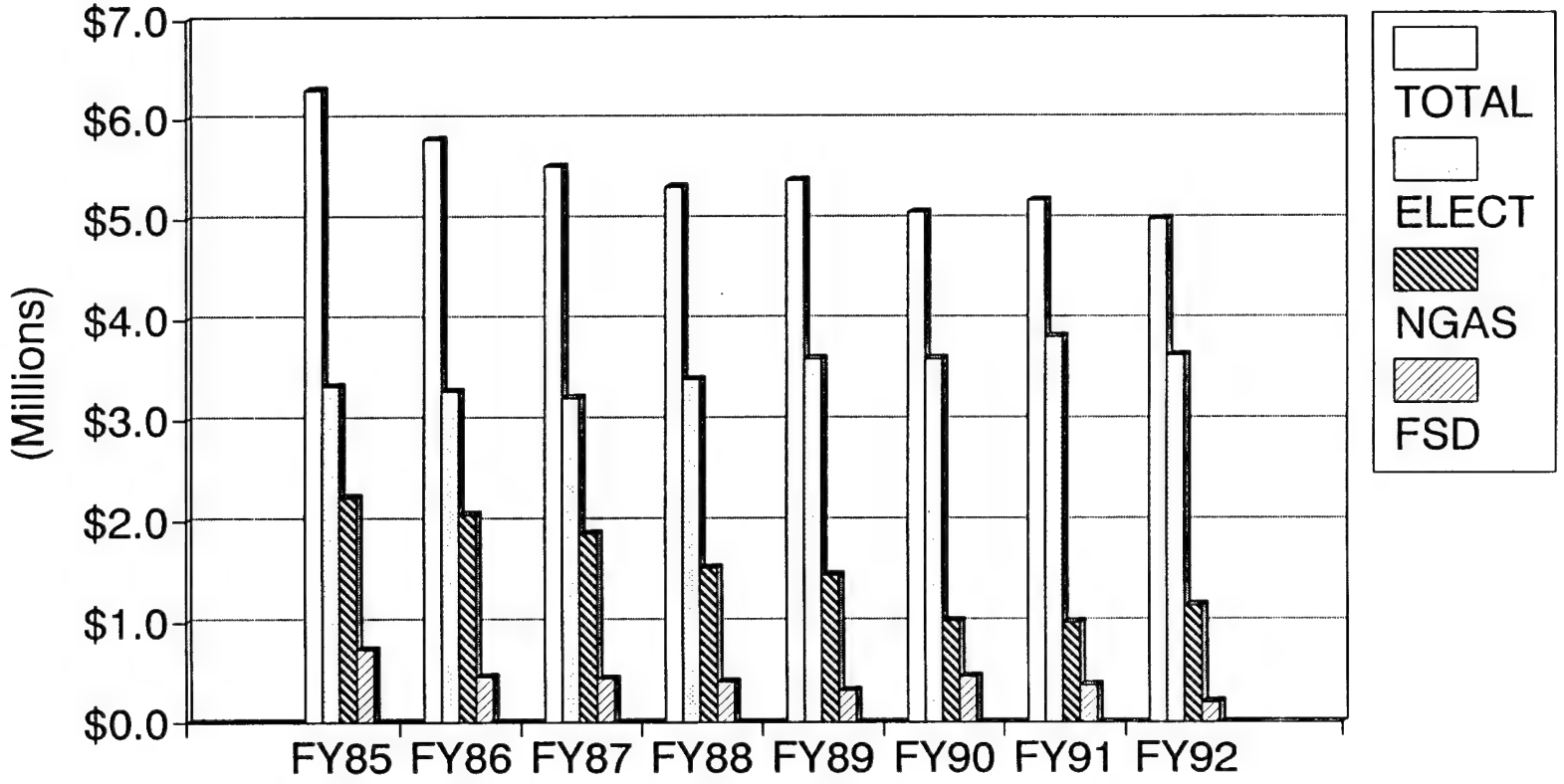


Figure 3-4

Source: ADDS

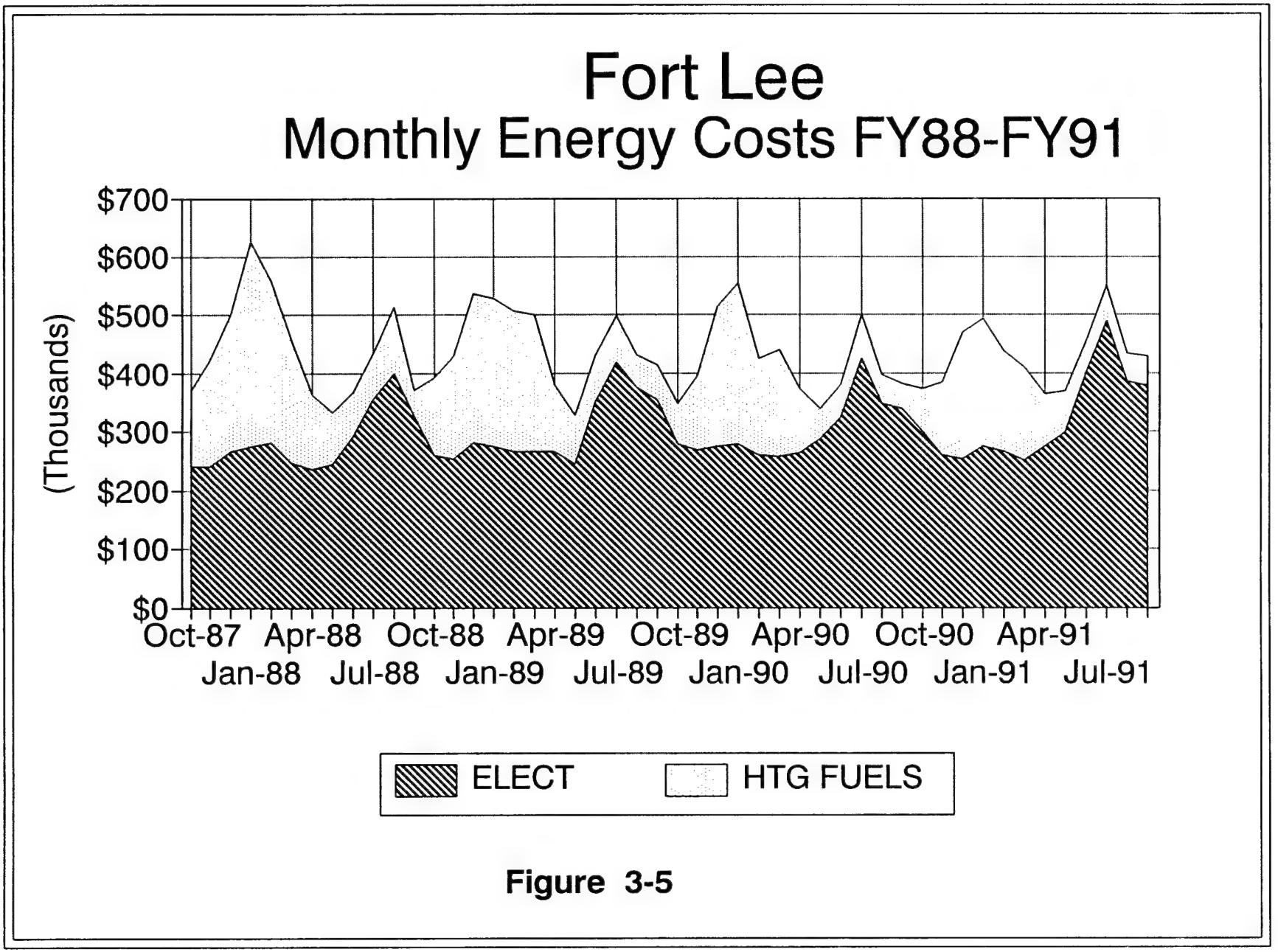

Fort Lee
Monthly Energy Costs FY88-FY91
(Thousands)
$700
$600
$500
$400
$300
$200
$100
$0
Oct-87
Apr-88
Oct-88
Apr-89
Oct-89
Apr-90
Oct-90
Apr-91
Jan-88
Jul-88
Jan-89
Jul-89
Jan-90
Jul-90
Jan-91
Jul-91
ELECT
HTG FUELS

Figure 3-5

Table 3-1 Fort Lee Energy Prices - FY 91

Electricity	
Average	4.7¢/kwh or $13.70/MBtu
Energy	2.0¢/kwh or $ 5.90/MBtu
Demand	$12.50/KW/month with 90% ratchet*
Reactive	15¢/rkVA
Natural Gas	$2.80/MBtu
Fuel Oil #2 (FSD)	$5.00/MBtu
Fuel Oil #6 (FSR)	$4.40/MBtu

*The ratchet clause and its effects on Fort Lee utility costs are explained later in this section.

Figure 3-6 displays monthly energy costs at Fort Lee. As in the case of consumption, heating fuel costs vary widely, depending on weather. Electricity costs are a significant portion of the monthly costs, and can range from 60 percent of the monthly total to 90+ percent. Electricity costs dominate the total annual energy bill because of the higher unit price. In FY 91, electricity costs represented 74 percent of the total expense of $5,200,000 (Figure 3-7). Demand charges are more than 50 percent of the total electric bill.

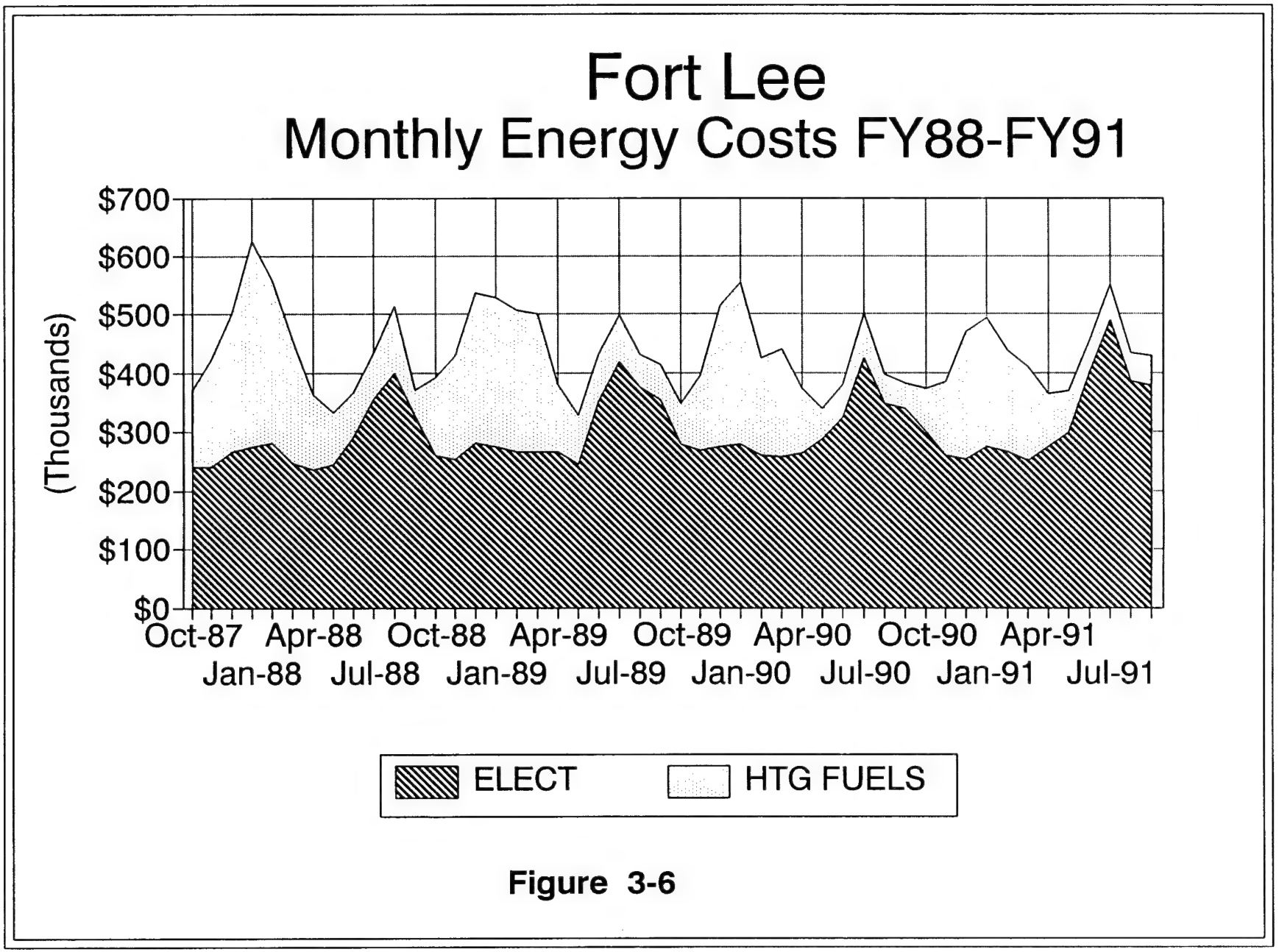
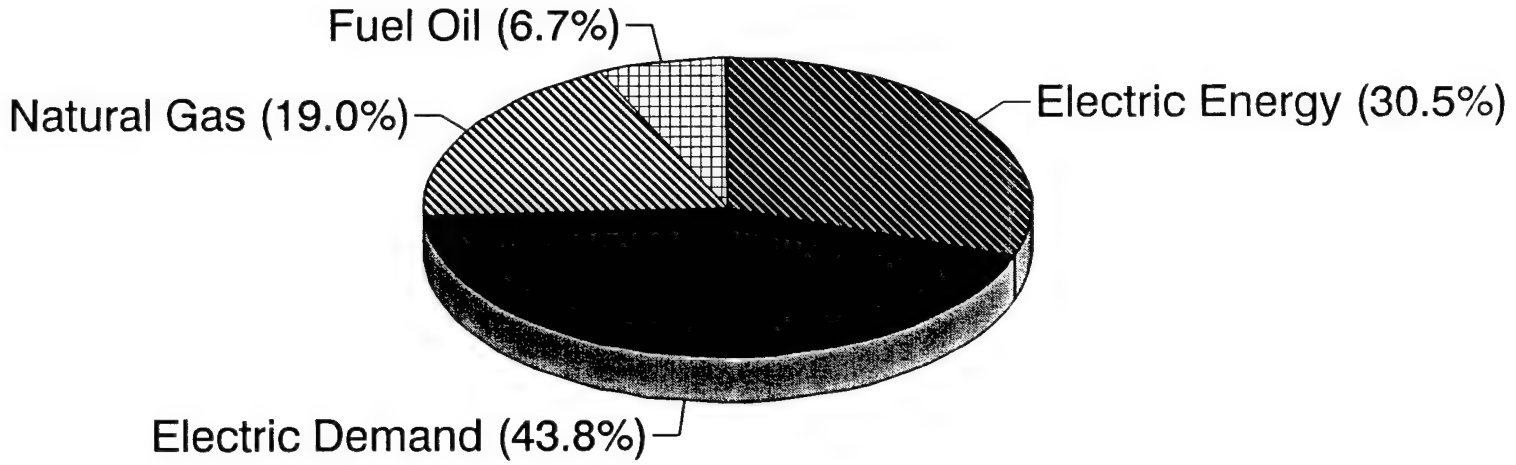

Fort Lee
Monthly Energy Costs FY88-FY91
(Thousands)
$700
$600
$500
$400
$300
$200
$100
$0
Oct-87
Apr-88
Oct-88
Apr-89
Oct-89
Apr-90
Oct-90
Apr-91
Jan-88
Jul-88
Jan-89
Jul-89
Jan-90
Jul-90
Jan-91
Jul-91
ELECT
HTG FUELS

Figure 3-6

FORT LEE

FY91 Facility Energy Cost



Total Cost = $ 5,192,400

Figure 3-7

4.0 ENERGY CONSERVATION OPPORTUNITY ANALYSIS

4.1 Energy Conservation Opportunity (ECO) Evaluations

Each of the ECOs listed in the Scope of Work plus others were reviewed for their applicability and potential for significant energy savings and cost effectiveness for buildings representative of high energy consumption process areas at Fort Lee.

For each of the ECOs that were chosen to be evaluated, energy savings were calculated, cost estimates made and Life Cycle Cost Analyses performed. The evaluated ECOs are listed in Table 4-1. A listing of evaluated ECOs along with a summary of the energy and cost savings analysis is shown in Table 4-2. Table 4-3 contains a listing prioritized by SIR. Table 4-4 contains a list prioritized by simple payback. Backup data and calculations are contained in Appendix B.

Table 4-1. ECOs Evaluated--Titles

ECO #	Description
1	Kitchen fluorescents
2	Efficient fluorescents and ballasts
3	Not used
4	Infrared heaters
5	Not used
6	Hot refrigerant gas reclaim
7	Not used
8	Boiler oxygen trim control
9	Boiler burner replacement
10	DHW heat pumps
11	Exhaust heat recovery
12	Occupancy sensors
13	Daylight sensors
14	Separate switching
15	Energy efficient boilers
16	Generator auto controls
17	Water system regulators
18	Thermal storage
19	Direct digital control
20	Power factor improvement
21	Compact fluorescent lamps
22	EMCS Graphics Operator Interface
23	FH hot gas reclaim
24	Hot water conversion
25	Boiler stack heat reclaim
26	Electric dryers fuel switch
27	Cogeneration
28	Generator fuel switch
29	EMCS lighting control
30	Reduce hydrant flushing
31	Fixed orifice steam trap
32	Absorption chiller
33	Off-peak water pumping
34	Range electronic ignition
35	Gas engine-driven chiller

Table 4-2. ECO Evaluations - Results

No.	ECO #	Project Name	Construction Cost Plus SIOH	Savings (Increase), MBtu/Year Elec	Dist	N Gas	Net Annual Cost Savings	SIR	Simple Payback (Years)
1	1	Kitchen fluorescents	$31,110	92	0	0	$3,080	1.0	10.7
2	2	Efficient fluorescents and ballasts	$720,910	5,160	0	0	$113,990	1.6	6.7
3	3	Not used	-	-	-	-	-	-	-
4	4	Infrared heaters	-	-	-	-	-	-	-
5	5	Not used	-	-	-	-	-	-	-
6	6A	Hot refrigerant gas reclaim (Elc) (1)	$1,300	22	0	0	$300	3.0	4.6
7	6B	Hot refrigerant gas reclaim (Ngas) (1)	$1,300	0	0	27	$75	1.0	18.2
8	7	Not used	-	-	-	-	-	-	-
9	8	Boiler oxygen trim controls	-	-	-	-	-	-	-
10	9	Boiler burner replacement (1)	$6,200	0	0	502	$1,400	3.7	4.7
11	10	DHW heat pumps	-	-	-	-	-	-	-
12	11	Exhaust heat recovery	$24,300	41	0	416	$1,730	1.1	14.9
13	12	Occupancy sensors	$15,530	445	0	0	$5,500	3.8	3.0
14	13	Daylight sensors	$9,140	127	0	0	$1,740	2.0	5.6
15	14	Separate switching	$1,480	144	0	0	$850	6.0	1.8
16	15	Energy efficient boilers (1)	$45,580	0	0	3,510	$9,480	2.5	5.1
17	16	Generator auto controls	-	-	-	-	-	-	-
18	17	Water system regulators	-	-	-	-	-	-	-
19	18	Thermal storage	$466,400	(48)	0	0	$55,770	1.5	8.8
20	18A	Thermal storage	$599,960	(86)	0	0	$58,104	1.2	10.9
21	18B	Thermal storage	$159,000	30	0	0	$16,803	1.3	10.0
22	19	Direct digital control	-	-	-	-	-	-	-
23	20	Power factor improvement	$37,510	0	0	0	$2,400	0.8	16.5
24	21	Compact fluorescent lamps	$11,710	196	0	0	$6,170	5.4	2.0
25	22	EMCS Graphics Operator Interface	-	-	-	-	-	-	-
26	23	FH hot gas reclaim (1)	$1,300	14	0	0	$40	0.5	35.4
27	24	Hot water conversion	-	-	-	-	-	-	-
28	25	Boiler stack heat reclaim	-	-	-	-	-	-	-
29	26	Electric dryers fuel switch (1)	$9,000	162	0	(181)	$1,700	2.3	5.6
30	27	Cogeneration	-	-	-	-	-	-	-
31	28	Generator fuel switch	$292,000	0	2,785	(2,785)	$6,100	0.2	50.4
32	29	EMCS lighting control	-	-	-	-	-	-	-
33	30	Reduce hydrant flushing	-	-	-	-	-	-	-
34	31	Fixed orifice steam traps	$44,400	0	0	13,500	$37,800	10.3	1.2
35	32	Absorption chillers	$478,300	935	0	(5,754)	$17,300	0.6	18.7
36	33	Off-peak water pumping	$33,000	0	0	0	$12,200	2.8	2.9
37	34	Range electronic ignition	$1,313,700	1,214	0	1,261	$10,690	0.1	129.8
38	35	Gas engine-driven chiller	$464,300	1,070	0	(3,534)	$25,700	0.9	13.9

(1) Analysis on per-unit basis.

Table 4-3. ECO Evaluations - Results by SIR

No.	ECO #	Project Name	Construction Cost Plus SIOH	Savings (Increase), MBtu/Year Elec	Dist	N Gas	Net Annual Cost Savings	SIR	Simple Payback (Years)
1	31	Fixed orifice steam traps	$44,400	0	0	13,500	$37,800	10.3	1.2
2	14	Separate switching	$1,480	144	0	0	$850	6.0	1.8
3	21	Compact fluorescent lamps	$11,710	196	0	0	$6,170	5.4	2.0
4	12	Occupancy sensors	$15,530	445	0	0	$5,500	3.8	3.0
5	9	Boiler burner replacement (1)	$6,200	0	0	502	$1,400	3.7	4.7
6	6A	Hot refrigerant gas reclaim (Elc) (1)	$1,300	22	0	0	$300	3.0	4.6
7	33	Off-peak water pumping	$33,000	0	0	0	$12,200	2.8	2.9
8	15	Energy efficient boilers (1)	$45,580	0	0	3,510	$9,480	2.5	5.1
9	26	Electric dryers fuel switch (1)	$9,000	162	0	(181)	$1,700	2.3	5.6
10	13	Daylight sensors	$9,140	127	0	0	$1,740	2.0	5.6
11	2	Efficient fluorescents and ballasts	$720,910	5,160	0	0	$113,990	1.6	6.7
12	18	Thermal storage	$466,400	(48)	0	0	$55,770	1.5	8.8
13	18B	Thermal storage	$159,000	30	0	0	$16,803	1.3	10.0
14	18A	Thermal storage	$599,960	(86)	0	0	$58,104	1.2	10.9
15	11	Exhaust heat recovery	$24,300	41	0	416	$1,730	1.1	14.9
16	1	Kitchen fluorescents	$31,110	92	0	0	$3,080	1.0	10.7
17	6B	Hot refrigerant gas reclaim (Ngas) (1)	$1,300	0	0	27	$75	1.0	18.2
18	35	Gas engine-driven chiller	$464,300	1,070	0	(3,534)	$25,700	0.9	13.9
19	20	Power factor improvement	$37,510	0	0	0	$2,400	0.8	16.5
20	32	Absorption chillers	$478,300	935	0	(5,754)	$17,300	0.6	18.7
21	23	FH hot gas reclaim (1)	$1,300	14	0	0	$40	0.5	35.4
22	28	Generator fuel switch	$292,000	0	2,785	(2,785)	$6,100	0.2	50.4
23	34	Range electronic ignition	$1,313,700	1,214	0	1,261	$10,690	0.1	129.8

(1) Analysis on per-unit basis.

Table 4-4. ECO Evaluations - Results by Simple Payback

No.	ECO #	Project Name	Construction Cost Plus SIOH	Savings (Increase), MBtu/Year Elec	Dist	N Gas	Net Annual Cost Savings	SIR	Simple Payback (Years)
1	31	Fixed orifice steam traps	$44,400	0	0	13,500	$37,800	10.3	1.2
2	14	Separate switching	$1,480	144	0	0	$850	6.0	1.8
3	21	Compact fluorescent lamps	$11,710	196	0	0	$6,170	5.4	2.0
4	33	Off-peak water pumping	$33,000	0	0	0	$12,200	2.8	2.9
5	12	Occupancy sensors	$15,530	445	0	0	$5,500	3.8	3.0
6	6A	Hot refrigerant gas reclaim (Elc) (1)	$1,300	22	0	0	$300	3.0	4.6
7	9	Boiler burner replacement (1)	$6,200	0	0	502	$1,400	3.7	4.7
8	15	Energy efficient boilers (1)	$45,580	0	0	3,510	$9,480	2.5	5.1
9	13	Daylight sensors	$9,140	127	0	0	$1,740	2.0	5.6
10	26	Electric dryers fuel switch (1)	$9,000	162	0	(181)	$1,700	2.3	5.6
11	2	Efficient fluorescents and ballasts	$720,910	5,160	0	0	$113,990	1.6	6.7
12	18	Thermal storage	$466,400	(48)	0	0	$55,770	1.5	8.8
13	18B	Thermal storage	$159,000	30	0	0	$16,803	1.3	10.0
14	1	Kitchen fluorescents	$31,110	92	0	0	$3,080	1.0	10.7
15	18A	Thermal storage	$599,960	(86)	0	0	$58,104	1.2	10.9
16	35	Gas engine-driven chiller	$464,300	1,070	0	(3,534)	$25,700	0.9	13.9
17	11	Exhaust heat recovery	$24,300	41	0	416	$1,730	1.1	14.9
18	20	Power factor improvement	$37,510	0	0	0	$2,400	0.8	16.5
19	6B	Hot refrigerant gas reclaim (Ngas) (1)	$1,300	0	0	27	$75	1.0	18.2
20	32	Absorption chillers	$478,300	935	0	(5,754)	$17,300	0.6	18.7
21	23	FH hot gas reclaim (1)	$1,300	14	0	0	$40	0.5	35.4
22	28	Generator fuel switch	$292,000	0	2,785	(2,785)	$6,100	0.2	50.4
23	34	Range electronic ignition	$1,313,700	1,214	0	1,261	$10,690	0.1	129.8

(1) Analysis on per-unit basis.

4.2 Multiple ECO Project Evaluations

ECIP 1--Energy-Efficient Lighting. This project combines several lighting retrofit ECOs as listed below:

ECO #	ECO Description
2	T8 System
12	Occupancy Sensors
13	Daylight Sensors
14	Separate Switching

ECO 2 is the dominant part representing a construction cost nearly $700,000. This ECO recommends replacing existing 34- and 40-watt fluorescent lamps and standard ballasts with 32-watt T8 lamps and electronic ballasts.

Occupancy sensors are recommended for restroom lighting in both barracks and administrative/instructional buildings. Separate switching is called for in Building 11200 to allow for partial use of the various floors.

The life-cycle cost analysis program LCCID 1.065, was used to determine the cost/benefits of this ECIP. Based on the energy savings to Fort Lee, it is recommended.

ECIP 2--Thermal Energy Storage. Thermal storage systems utilize an electric chiller to produce ice or chilled water during off-peak hours (usually at night) and stores it in an insulated tank for later use. Then instead of using the chiller during the day when the peak electric demand occurs, the stored cooling capacity is used to satisfy all or a portion of the building's air conditioning load.

The system recommended here is chilled water storage. The chilled water storage system utilizes the existing chiller (which lowers the system's capital cost) to produce chilled water at night. The chilled water is stored in an insulated above-ground steel tank. The chilled water is thermally stratified in the storage tank by inlet and outlet diffusers or separated by a thin membrane to reduce heat transfer loss between the chilled supply water and warmer return water.

The thermal storage system is recommended for buildings 10500, 4200 and 4210.

5.0 ENERGY PLAN

5.1 Project Packaging

The ECOs listed in Table 4-2 were evaluated for appropriate funding category. The project scope of work listed the following guidelines on this subject.

	Project Cost	Simple Payback
QRIP	< $100,000	≤ 2 yrs.
OSD PIF	> $100,000	≤ 4 yrs.
PECIP	> $100,000	≤ 4 yrs.
ECIP	> $200,000	≤ 10 yrs., SIR > 1.0
MCA	> $200,000	≤ 25 yrs., ≥ 8 yrs.

DA Form 1391 is required only for those ECIP and MCA projects costing greater than $200,000. Otherwise, DA Form 5108-R from AR 5-4 is used.

Table 5-1 contains the results of the analysis with the project funding category listed in the far right column and is summarized in Table 5-2. Table 5-3 lists the ECOs by project funding category.

Five ECOs 9, 11, 15, 26 and 33 have SIRs > 1, but do not meet other dollar or payback requirements for special funding. ECO 18 and 18B are recommended in favor of alternate 18A. ECO 2 is a combination of options D, E and F. ECO 6A is favored over 6B.

5.2 Energy and Cost Savings

Energy and cost savings for the recommended project funding are listed in Table 5-4. Project capital costs are escalated at 4 percent per year according to the project implementation schedule as discussed below. Energy costs are in constant dollars using FY 92 prices. The implementation of all projects yield a total annual energy savings of 24,026 MBtu and annual cost savings equal to $265,600, which represents a reduction of three percent and four percent, respectively in energy use and cost when compared to FY 91 values. Figures 5-1 through 5-4 show energy use and cost at Fort Lee before and after implementation of these projects. These amounts are about half the savings we have recommended at other Army installations. The primary reason is the low price of electricity and natural gas. Figures 5-4 and 5-6 do not

Table 5-1. ECO Evaluations - Project Funding - Sorted by Simple Payback

No.	ECO #	Construction Cost Plus SIOH	Savings (Increase), MBtu/Year Elec	Dist	N Gas	Net Annual Cost Savings	SIR	Simple Payback (Years)	Project Funding
1	31	$44,400	0	0	13,500	$37,800	10.3	1.2	QRIP #1
2	14	$1,480	144	0	0	$850	6.0	1.8	ECIP #1
3	21	$11,710	196	0	0	$6,170	5.4	2.0	QRIP #2
4	33	$33,000	0	0	0	$12,200	2.8	2.9	NF
5	12	$15,530	445	0	0	$5,500	3.8	3.0	ECIP #1
6	6A	$1,300	22	0	0	$300	3.0	4.6	LC/NC
7	9	$6,200	0	0	502	$1,400	3.7	4.7	NF
8	15	$45,580	0	0	3,510	$9,480	2.5	5.1	NF
9	13	$9,140	127	0	0	$1,740	2.0	5.6	ECIP #1
10	26	$9,000	162	0	(181)	$1,700	2.3	5.6	NF
11	2	$720,910	5,160	0	0	$113,990	1.6	6.7	ECIP #1
12	18	$466,400	(48)	0	0	$55,770	1.5	8.8	ECIP #2
13	18B	$159,000	30	0	0	$16,803	1.3	10.0	ECIP #2
14	1	$31,110	92	0	0	$3,080	1.0	10.7	NF
15	18A	$599,960	(86)	0	0	$58,104	1.2	10.9	NF
16	35	$464,300	1,070	0	(3,534)	$25,700	0.9	13.9	NR
17	11	$24,300	41	0	416	$1,730	1.1	14.9	NF
18	20	$37,510	0	0	0	$2,400	0.8	16.5	NR
19	6B	$1,300	0	0	27	$75	1.0	18.2	NF
20	32	$478,300	935	0	(5,754)	$17,300	0.6	18.7	NR
21	23	$1,300	14	0	0	$40	0.5	35.4	NR
22	28	$292,000	0	2,785	(2,785)	$6,100	0.2	50.4	NR
23	34	$1,313,700	1,214	0	1,261	$10,690	0.1	129.8	NR

NF = Not funded, SIR > 1, but does not meet dollar or payback requirements for special funding.
NR = Not recommended, SIR < 1.

Table 5-2. ECO Evaluations - Project Funding Summary - Grouped By Funding Category

No.	ECO #	Project Name	Construction Cost Plus SIOH	SIR	Simple Payback (Years)	Project Funding
1	12	Occupancy sensors	$15,530	3.8	3.0	ECIP #1
2	13	Daylight sensors	$9,140	2.0	5.6	ECIP #1
3	2	Efficient fluorescents and ballasts	$720,910	1.6	6.7	ECIP #1
4	14	Separate switching	$1,480	6.0	1.8	ECIP #1*
5	18	Thermal storage	$466,400	1.5	8.8	ECIP #2
6	18B	Thermal storage	$159,000	1.3	10.0	ECIP #2
7	6A	Hot refrigerant gas reclaim (Elc)	$1,300	3.0	4.6	LC/NC
8	1	Kitchen fluorescents	$31,110	1.0	10.7	NF
9	11	Exhaust heat recovery	$24,300	1.1	14.9	NF
10	15	Energy efficient boilers	$45,580	2.5	5.1	NF
11	18A	Thermal storage	$599,960	1.2	10.9	NF
12	26	Electric dryers fuel switch	$9,000	2.3	5.6	NF
13	33	Off-peak water pumping	$33,000	2.8	2.9	NF
14	6B	Hot refrigerant gas reclaim (Ngas)	$1,300	1.0	18.2	NF
15	9	Boiler burner replacement	$6,200	3.7	4.7	NF
16	20	Power factor improvement	$37,510	0.8	16.5	NR
17	23	FH hot gas reclaim	$1,300	0.5	35.4	NR
18	28	Generator fuel switch	$292,000	0.2	50.4	NR
19	32	Absorption chillers	$478,300	0.6	18.7	NR
20	34	Range electronic ignition	$1,313,700	0.1	129.8	NR
21	35	Gas engine-driven chiller	$464,300	0.9	13.9	NR
22	21	Compact fluorescent lamps	$11,710	5.4	2.0	QRIP #1
23	31	Fixed orifice steam traps	$44,400	10.3	1.2	QRIP #2

*Qualifies for QRIP, but was combined into lighting ECIP #1.
NF = Not funded, SIR > 1, but does not meet dollar or payback requirements for special funding.
NR = Not recommended, SIR < 1.

Table 5-3. Project Funding List

Fund	ECO ID	Project Description
QRIP #1	31	Fixed orifice steam traps
QRIP #2	21	Compact fluorescent lamps
ECIP #1	2, 12, 13, 14	Replace existing fluorescents with T8 lamps and electronic ballasts. Install occupancy sensors, daylight sensors and modify lighting circuit switching
ECIP #2	18, 18B	Thermal energy storage
Low Cost/ No Cost	6A	Hot refrigerant gas reclaim

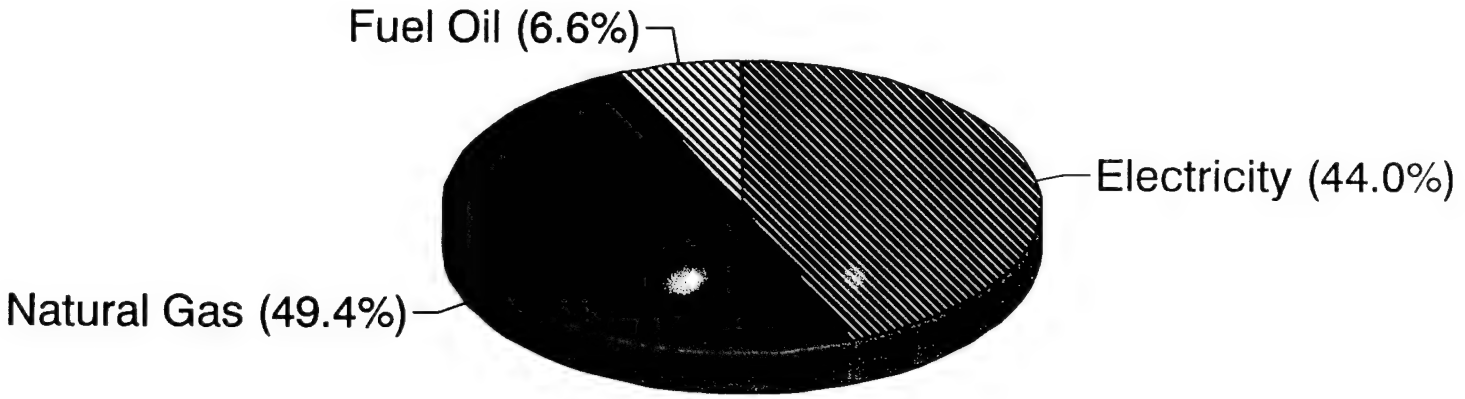
Table 5-4. Energy and Cost Savings for Recommended Projects

Project	Names		Construction Cost Plus SIOH[1]	Annual Energy Savings MBtu/yr	Annual Energy Savings $[2]	Project Type	FY
21		Compact fluorescent lamps	$12,700	196	$6,200	QRIP #2	94
31		Fixed orifice steam traps	$48,000	13,500	$37,800	QRIP #1	94
2, 12, 13, 14		Energy Efficient Lighting	$908,900	5,876	$122,300	ECIP #1	97
18, 18B		Thermal energy storage	$760,900	(18)	$72,500	ECIP #2	97
6A		Hot gas reclaim	$1,400	22	$300	LC/NC[3]	94
9, 11, 15, 26, 33		Others	$143,700	4,450	$26,500	NFs[4]	97
	TOTALS		$1,875,600	24,026	$265,600		

[1]Escalated to year of implementation at four percent/year.
[2]Energy costs are in constant FY92 dollars.
[3]LC/NC = low cost/no cost.
[4]NFs = projects with SIR > 1.0, but did not qualify for special funding.

FORT LEE

FY91 Facility Energy Use

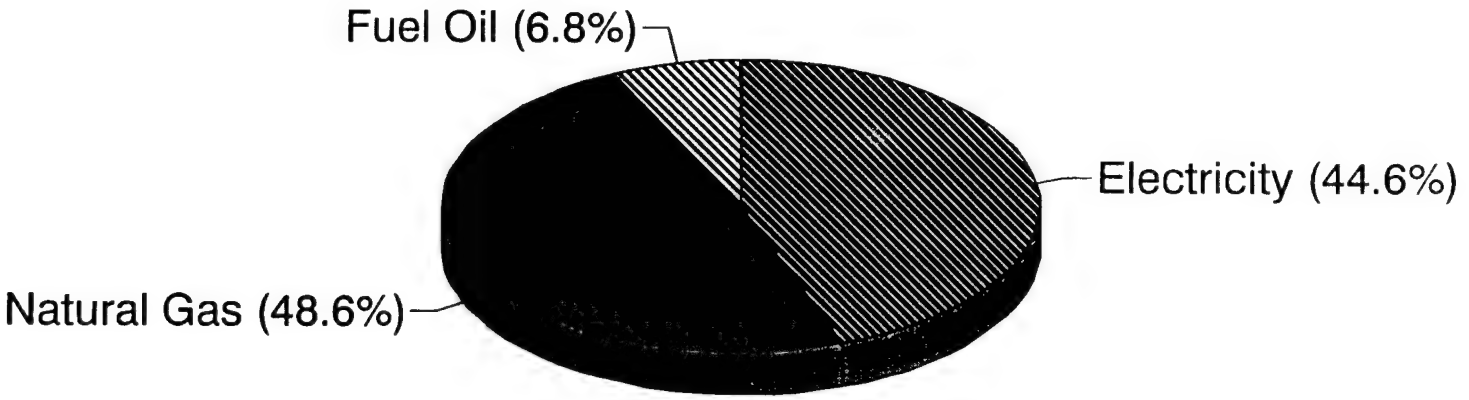


Total Use = 712,600 MBtu

Figure 5-1

FORT LEE

Effects of Projects on Energy Use

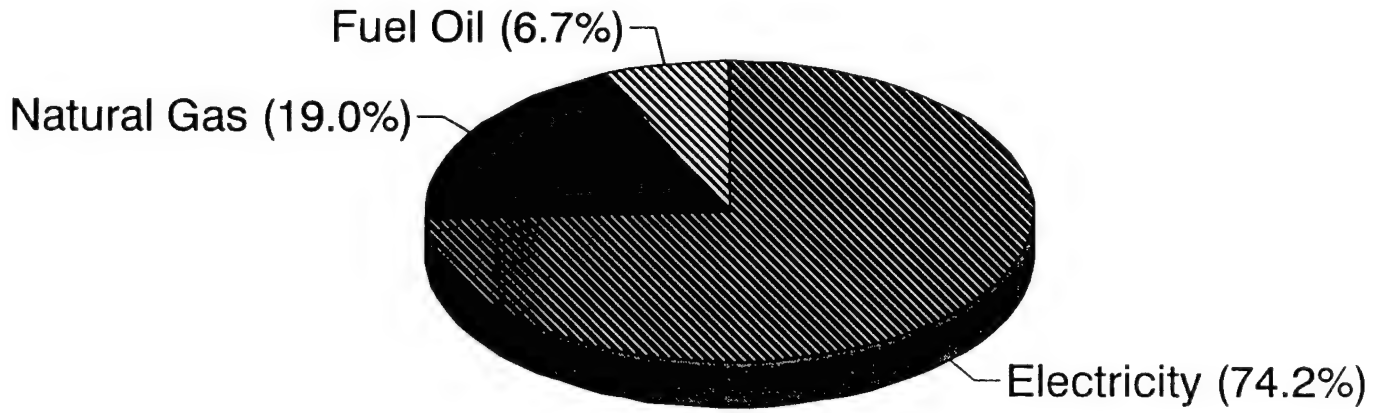


Total Use = 688,500 MBtu

Figure 5-2

FORT LEE

FY91 Facility Energy Cost

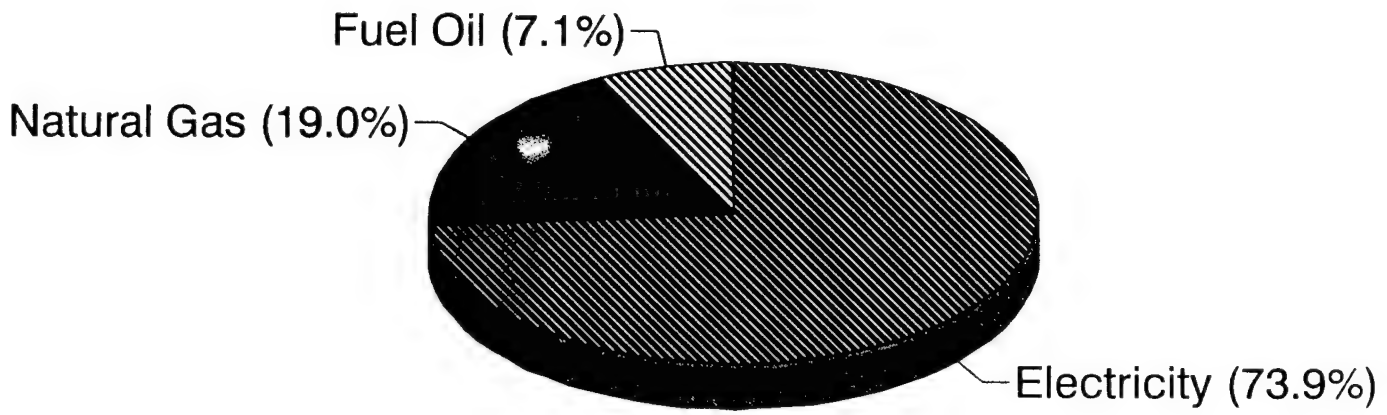


Total Cost = $ 5,192,400

Figure 5-3

FORT LEE

Effects of Projects on Energy Cost



Total Cost = $ 4,926,800

Figure 5-4

reflect the true cost savings since electricity prices increased in FY 92 over FY 91.

5.3 Project Schedule

Project implementation dates are estimated as follows:

QRIP, OSD PIF	FY 94
ECIP, MCA	FY 97

Following this schedule, Figures 5-5 and 5-6 show how implementation of the recommended projects reduce energy use and cost, respectively, at Fort Lee.

5.4 Environmental Impact

Another benefit of reducing energy use is the accompanying reduction in emissions from heating plants and electric utilities. Table 5-5 contains the results of an analysis performed using emission data collected from engineering periodicals and Virginia Power Corporation. When all projects are implemented, the reduction of emissions in the atmosphere are over 16 tons each year in the form of sulfur dioxide, nitrous oxides, and particulates. Carbon dioxide emissions, which are considered by many to contribute to global warming, are reduced by 2,500 tons annually.

FORT LEE

Effects of Projects on Energy Use

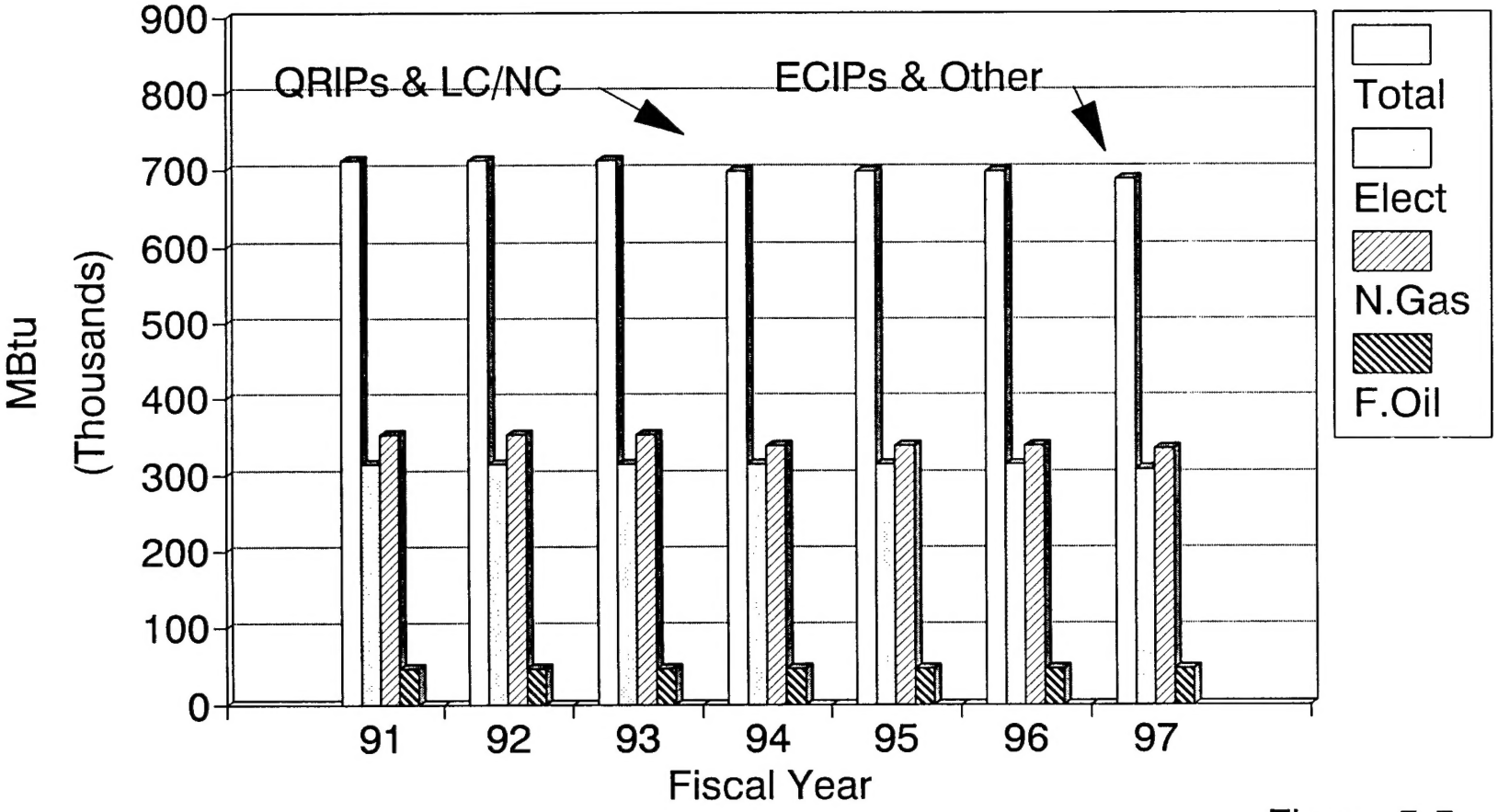


Figure 5-5

FORT LEE

Effects of Projects on Energy Cost

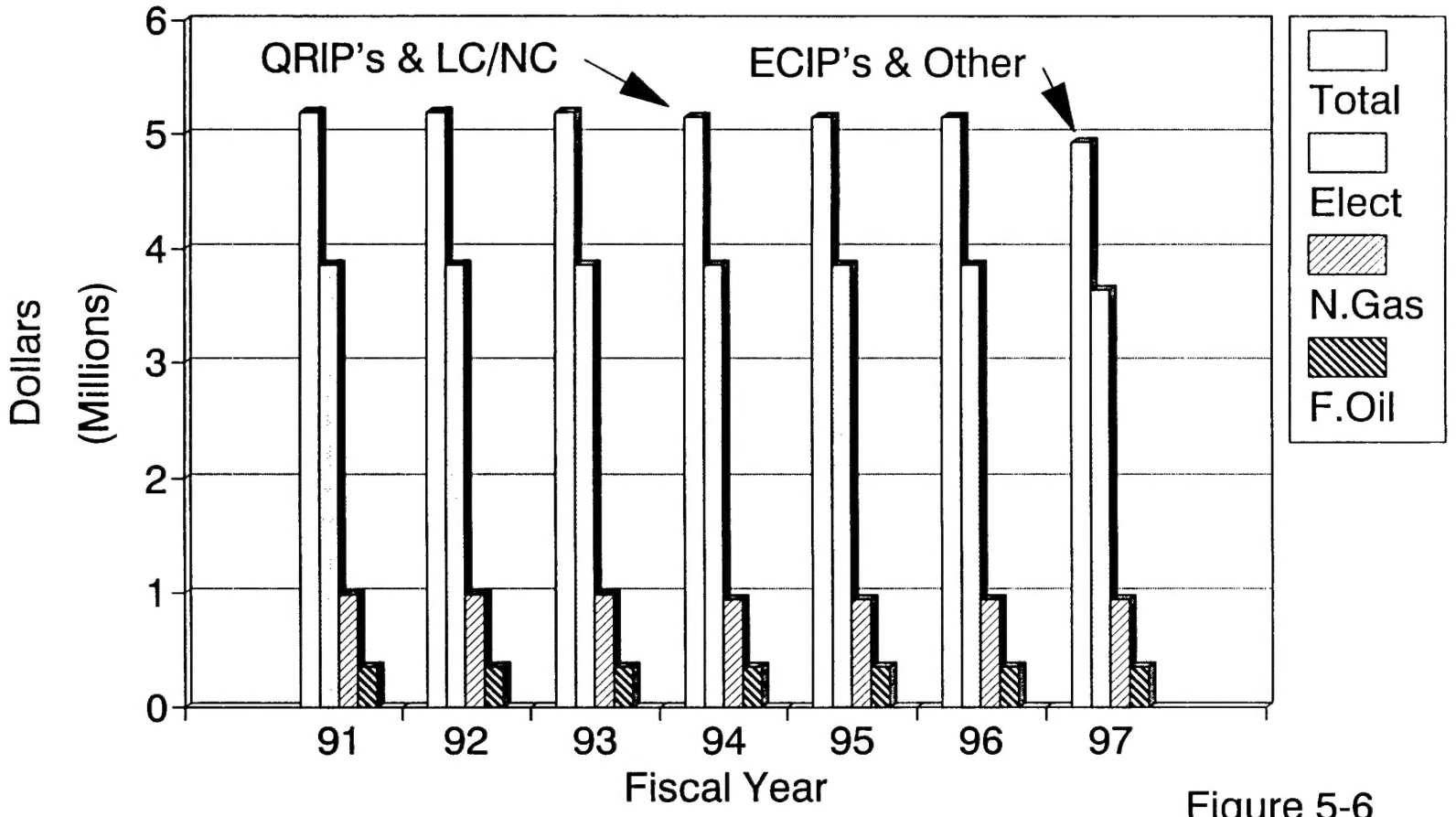


Figure 5-6

Table 5-5 Emission Reductions Due to Energy Saving Projects

ECO #	Project Name	Emissions (lbs/yr) SO2	NOx	Part.	CO2
21	Replace Incandescents	700	100	100	95,300
31	Fixed orifice traps	0	3,400	0	1,485,000
2,12,13,14	En. Eff. Lighting	20,700	3,400	1,700	2,857,900
18, 18B	Thermal Storage	(100)	0	0	(8,800)
6A	Hot Gas Reclaim	100	0	0	10,700
9,11,15,26,33	Others	700	1,200	100	565,900
	TOTALS (lbs/yr)	22,100	8,100	1,900	5,006,000
	TOTALS (tons/yr)	11	4	1	2,500

SO2 - Sulfur Dioxide
NOx - Nitrogen Oxides
Part. - Particulates
CO2 - Carbon Dioxide